

New Hampshire Space Grant Consortium  
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## PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The New Hampshire Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2013.

## PROGRAM GOALS

The strategic goal of the New Hampshire Space Grant Consortium (NHSGC) is: *To stimulate and enhance awareness and understanding of our nation's continuing quest into space by providing 1) Support to New Hampshire's college and university students in space-related fields; 2) Space-related educational materials, programs, and resources to the State's educators; and, 3) Greater access to space-related information and technology for the benefit of the State, its businesses, and citizens.*

Particular emphasis and priority are given to the following goals:

- Providing fellowships, scholarships, and internships to the State's graduate and undergraduate (including community college) students pursuing studies in NASA-relevant science, engineering, and technology disciplines
- Providing resources, information, and training to the State's and region's educators in science, math, and technology
- Creating increased access to NASA-relevant science and technology through informal educational institutions and other programs oriented towards the general public
- Providing support for the State's community colleges
- Creating a greater impact on recruitment of underrepresented groups
- Providing pre-service and in-service science teacher training
- Supporting informal education/public service programs
- Fostering New Hampshire's new EPSCoR projects

The NHSGC partners are the University of New Hampshire (UNH), the Cooperative Extension at UNH, Dartmouth College, FIRST Place, the Community College System of New Hampshire (CCSNH), the McAuliffe-Shepard Discovery Center (MSDC), Plymouth State University (PSU), the Mount Washington Observatory (MWO), the Margret and H.A. Rey Center, and BAE Systems of North America.

The Consortium SMART objectives established in the award year four proposal (period of performance June 8, 2013 – June 7, 2014) are provided under the Program Accomplishments section, along with the actual achievement for each Outcome.

### PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

*Outcome 1: Many Community College students are non-traditional college students -- they may have a family, a mortgage, and be juggling one or more jobs along with their coursework. In these cases, the community college frequently acts as an affordable stepping-stone into the traditional 4-yr college system: "I am a full-time working adult with four children, one of whom is currently in college. I have been in the telecommunications industry for 19 years, with a focus on the design, construction, and maintenance of hybrid-fiber-coax networks used in CATV applications. I am currently enrolled in Great Bay's Engineering Science program, where I carry a 4.0 GPA and expect to graduate in the spring of 2014. From there, I will continue my studies at UNH, where I plan to earn a BS in Electrical Engineering which will support my continued career growth in the telecommunications industry. There are many challenges inherent in being a non-traditional student but scholarship opportunities such as this one can significantly help ease the dimension of those challenges."* R. Totten, Stafford, NH

*Outcome 2: Rey Center supplemental science programs cover a range of topics, including life science, Earth/space science, and physical science aligned to the New Hampshire SAU 48 Science Curriculum. "The Rey Center Staff has made science at Waterville Valley Elementary School relevant. Students look forward to the Rey Center teachers coming each month to enhance their understanding of the current topic.... We appreciate their enthusiasm. It is infectious!"* G. Hannigan, Principal Waterville Valley Elementary School

*Outcome 2: Project SMART provides high school students with hands-on experience building and carrying out a space science experiment, inspiring students to continue their studies in STEM. "I've never had a hands-on research experience and have actually never taken physics...but because of Project SMART, I now plan on taking physics next year and am more interested in pursuing science in college."* A. Z., High School Student, Peterborough, NH

### PROGRAM ACCOMPLISHMENTS

**Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals.*

### **Proposed and Achieved Metrics for Outcome 1 SMART Objectives**

- The consortium awarded 8% (8.5% of significant awards) in fellowships and scholarships to under-represented minorities, exceeding our minimum goal of 5.4% (based on National Center for Education Statistics (NCES) tables at the time of the proposal) as well as approaching the most recent (2011) NCES entry of 8.8% for New Hampshire.
- The consortium awarded 30% in fellowships and scholarships (F/S) to women (34% of significant F/S awards). This fell short of our 40% goal for F/S. However, for all awards (including Higher Education and Research Infrastructure), women constituted 45% of student awardees, reaching the NASA goal of 40%.
- Fourteen graduate fellowships were provided through UNH, Dartmouth College, and PSU, exceeding our goal 6 fellowships.
- 35 undergraduate scholarships were provided through UNH, CCSNH, and PSU, exceeding our goal of 25 scholarships.
- Travel and research support was provided to 8 students as of March 2014 (goal of 10).
- 26 internships were supported in NASA-related STEM disciplines, including informal education, exceeding our goal of 10 such internships.
- At least 10 Dartmouth plasma science seminars were provided, with Space Grant supporting travel for four speakers in the series.
- Expanded access to, and use of, remote imagery in New Hampshire through the incorporation of three new data sets (Landsat 5, LiDAR, and NAIP) made publically available through a web image service. Three webinar modules are planned for Spring 2014. The goal was one data set and two webinars.
- Provided longitudinal tracking of significant awards using the National Space Grant Foundation (NSGF) Tracking System. For the 2006-2013 inclusive period, 80% of significant awardees have been tracked to their next step.

Using Space Grant funds, we support student education and research in fields related to space physics, astronomy, remote sensing, aerospace engineering, mechanical engineering, Earth science, meteorology, technology, and other areas related to NASA interests. Dartmouth College, the University of New Hampshire (UNH), Plymouth State University (PSU), and the Community College System of New Hampshire (CCSNH) offer graduate fellowships and undergraduate scholarships. Dartmouth, UNH, PSU, and the McAuliffe-Shepard Discovery Center (MSDC) offer internships. At the graduate level, the objective is to attract a high-quality, diverse graduate student body in these fields. At the undergraduate level, the objective is to attract and retain students in these fields and to enhance their education by providing opportunities for them to supplement their standard classroom education by participating in authentic, cutting-edge research. Such activities include internships and conference travel.

#### ***1.1 Workforce Development -- Graduate Student Fellowships***

*Dartmouth College.* Three fellowships were awarded to Department of Physics and Astronomy graduate students and four to students in the Department of Earth Sciences (EARS).

Astronomy graduate student Christine Black worked on modeling observational constraints of Active Galactic Nuclei (AGN). The project involved varying the black hole mass of an AGN to see if the host galaxy would be identified as an AGN or if it would be classified as a star-forming galaxy. This topic was later switched from AGN to supernovae and supernova remnants, and she is currently working on a project to create a 3-D map of the unique jet at the top of the Crab Nebula using spectroscopic images. Philip Fernandes, a 5th year Ph.D. student, has focused on the analysis of data from the nightside sounding rocket MICA (Magnetosphere-Ionosphere Coupling in the Alfvén Resonator), launched in 2012 under the NASA Low Cost Access to Space (LCAS) Program. Specifically, he has been analyzing ionospheric thermal ion data acquired by a Dartmouth instrument aboard the MICA payload. Much of the analysis has included writing code in Matlab to extract, manipulate, and present the data, as well as develop ideal-model representations of the particle distributions for comparison to the in situ data. Graduate student Matt Broughton published a paper on observations of a new kind of auroral radio emission observed at South Pole Station. He also continued his thesis work on the origins of medium frequency (MF) burst, a natural radio emission observed at local substorm onset. This work has involved looking at bursty MF emissions observed by the DEMETER (Detection of ElectroMagnetic Emissions Transmitted from Earthquake Regions) satellite to determine if the radio emissions it saw were MF bursts. He has also been working with researchers at Princeton on an electron fluid code to simulate the mode conversion of MF burst from the Langmuir mode to the L mode.

Four graduate students in the Department of Earth Science were supported by Space Grant. Ph.D. student Sam Beal is using remote sensing to study the climate history of Peru. Ph.D. student Gifford Wong is conducting climate-related research on changes in the Greenland Ice Sheet. M.S. student Matt Bigl is developing a Holocene climate chronology of lake core sediment in the upper valley region of NH. M.S. student Maggie Baber is using both remote sensing and fieldwork to look at Holocene climate change in the Rwenzori mountains of Uganda.

Space Grant sponsors two awards given annually at Dartmouth College to selected graduate students in the space science, engineering or remote sensing fields, from among candidates nominated by faculty members. The goal is to recognize excellent students, thereby encouraging excellence among students and giving the best students an award to list on their curriculum vitae. The award has become quite competitive with many nominations in a typical year. Nominations are circulated to a panel consisting of one faculty member from each Space Grant department (Physics, Earth Sciences, and Engineering). The panel determines the awards based on the merits of the nominees. Excellence in research is the primary criterion, but departmental and community service and teaching are also considered. Typically at least one panel member has served on the previous year's panel, to provide continuity in judging the criteria. In 2013 the award went to Physics graduate student Matt Broughton, whose research has been described above.

*Plymouth State University.* PSU awarded one graduate fellowship to Ms. Sarah Al-Momar in the M.S. Applied Meteorology program for the 2013-2014 academic year. Sarah earned her B.S. degree from Valparaiso University and enrolled in the PSU program in Fall 2013. Sarah came to Plymouth State after working on a project at NCAR through the SOARS program studying 3-D lightning mapping and radar derived turbulence in severe thunderstorms. Sarah presented this work at the annual AMS meeting in Atlanta in February 2014 and plans to continue to work with her SOARS mentors and PSU's Eric Hoffman on this project for her M.S. degree.

Space Grant also funded another PSU graduate student, Ms. Katie Laro, during the summer and fall semesters of 2013. Katie completed her M.S. Thesis in December which examined the verification of a new lightning detection sensor developed by a New Hampshire company with lightning detection data from the networks available at the Kennedy Space Center (KSC). Katie and her mentor Prof. Jim Koerner presented her work at the National Space Grant Fall Meeting, held in Charleston, SC.

*University of New Hampshire.* UNH awarded three new graduate fellowships this year, while extending summer fellowships to two graduate students from last year (Stephanie Coster and Camden Ertley). Dara Feddersen, a Ph.D. student in Chemistry, is researching new and improved methods for measuring mercury in the Earth's atmosphere. She worked with a team to design and test a portable instrument that was used for ground-based measurements during NASA's September 2013 DISCOVER-AQ campaign in Houston. Ryan Cassotto, a Ph.D. student in Earth Systems Science, uses interferometric radar to study the boundary between a tidewater outlet glacier and the ocean in Greenland. He observes daily changes in the boundary, and how it influences the dynamics of ice and the seasonal flow of the glacier. Ryan's work is relevant to the NASA goal of improving understanding of how large ice sheets impact sea level. Nicholas Dowhaniuk, a Master's student in Natural Resources, is characterizing changes in landcover, land use, landscape pattern, and biomass due to industrial oil development in the Albertine Rift, a biodiversity hotspot in Uganda. This work is applicable to the NASA Land-Cover/Land-Use Change Program (LULUC), seeking to quantify, document, and understand how landcover and land use change by human activity affects ecosystems.

## ***1.2 Workforce Development -- Undergraduate Scholarships***

*Community College System of New Hampshire.* The Community Colleges of New Hampshire Foundation again offered its popular Space Grant Scholarships. The goal of the scholarship program is to encourage matriculation leading to careers in STEM disciplines of interest to NASA. Between fall 2013 and spring 2014, the Foundation awarded undergraduate scholarships to 26 promising students matriculating in STEM disciplines. The Foundation attempts to attract underrepresented and minority students. The network of community colleges also brings geographical diversity, and applicants from rural and urban areas. This past year, there were four awardees from Great Bay Community College in Portsmouth, seven from Nashua Community College, thirteen from NHTI—Concord's Community College, and two from River Valley Community

College in Claremont. As an industry partner, the Public Service Company of New Hampshire (PSNH) has supported the Community College System by providing the matching funds in this scholarship program for the past 13 years, enabling a total of nearly 425 scholarships to be awarded.

*Plymouth State University.* During the past grant year, Space Grant funded seven PSU undergraduate scholarships to students majoring in meteorology. One of the seniors will be graduating in June with one of the highest Grade Point Averages (GPAs) ever earned by any PSU meteorology major, and interned in the Juneau, Alaska National Weather Service Forecast Office last summer. The other undergraduates are all completing their sophomore or junior years and continuing to maintain sterling GPAs and remain highly motivated in their STEM discipline.

*University of New Hampshire.* Student support was provided to two Elizabeth City State University (ECSU; a minority serving institution) undergraduate students who worked during this past fall semester on research projects with UNH mentors. Michael Cobb worked with UNH mentor Jeffrey Schloss of the Cooperative Extension (Natural Resources), while Alicia Reynolds worked with Barry Rock of the Earth Systems Science center. A previous space grant award recipient of this program, Ryan Lawrence, graduated from ECSU and is now a graduate student at UNH. This is the first successful recruitment from the UNH-ECSU collaboration to have an ECSU alumnus continuing their study as a graduate student at UNH.

### ***1.3 Workforce Development – Higher Education Hands-on Experience***

*Internships.* Internships provide hands-on activities that engage and sustain students in NASA-related STEM fields. These internships take place both within New Hampshire institutions of higher learning and at NASA Centers. Internships are carried out and completed under the supervision of sponsoring researchers. With summer internships at a NASA center, we also enhance connections and collaborations between New Hampshire research institutions of higher learning and the NASA centers. In the cases of many of the undergraduate interns the culminating experience is completing a poster to display at the Wetterhahn Science Symposium (Dartmouth, May of each year), the Undergraduate Research Conference (UNH, April of each year), or at a professional conference.

*Dartmouth College.* Katherine Wang, a sophomore majoring in computer science and economics, was a WISP intern at the Jet Propulsion Laboratory (JPL) from December 2013 – March 2014. Katherine worked on the Mars 2020 Mission with Mr. Yang Cheng in the robotics department. She assisted in the development and testing of algorithms for vision-based perception systems for an unmanned surface vehicle.

Dartmouth undergraduate Will Voight worked with Dartmouth Professor Yorke Brown to develop flight systems for ALTAIR (Airborne Laser for Telescopic Atmospheric Interference Reduction), a program that uses small stratospheric balloon payloads to measure atmospheric transmission. Will developed a VHF beacon receiver to assist in the recovery of payloads after flight.

Three Dartmouth undergraduates from the Earth Science Department were supported for a remote sensing project on water resources in China; and another two undergraduates in Engineering received internships.

Dartmouth's Women in Science Project (WISP) Internship Program provides first and second year undergraduate women with paid, part-time research opportunities with scientists. The interns present their research in poster form at the annual Wetterhahn Science Symposium in May. Space Grant helped to support 14 WISP interns this past year.

*McAuliffe-Shepard Discovery Center.* This year's Space Grant internships were focused on upgrading STEM exhibit technology, making exhibits more interactive, as well as creating associated STEM activities to augment the exhibits. Undergraduates Shannon Nollet (a junior majoring in computer science and mathematics at Washington and Lee University), Emily Sanseverino (a sophomore majoring in biomedical engineering at Rochester Institute of Technology) and Paul Hanlon (a sophomore majoring in mechanical engineering at New England College) were selected as the McAuliffe-Shepard Discovery Center (MSDC) Space Grant Interns. Nollet used Arduino microcontroller technology to work on a laser transmitter and receiver to 'beam' information across the exhibit gallery. She also prototyped a way to make MSDC's *Lunar Recon* exhibit more interactive by hiding messages in Lunar craters using ultraviolet paint. Sanseverino helped run Lego Mindstorms engineering activities during a weeklong summer camp for middle school girls. The Lego Mindstorms activities were the girls' favorite part of the camp! She also developed a "shake table" to help enhance visitors' experience in MSDC's *Lunar Recon* exhibit and helped to plan a future Mars rover interactive exhibit. Hanlon prototyped exhibits that will be part of MSDC's future "engineering corner." Hanlon also built a paper airplane launcher as part of a "build a paper airplane" exhibit-related activity that has been a visitor favorite. He also has helped to repair exhibits and brainstorm ideas for MSDC's science playground, slated to open in 2014.

*University of New Hampshire.* Two undergraduates from Elizabeth City State University took part in Summer Internships at UNH during Summer 2013: Crystal Yelverton and Alicia Reynolds. Crystal worked with Dr. Ruth Varner on a study of wetland ecosystem chemistry. Crystal collected samples of methane and carbon dioxide at a research site in Barrington, NH. She then analyzed the samples to determine gas flux at a lab on the UNH campus. Alicia's interest in Math Education made her a great match for the KEEPERS (Kids Eager for Engineering Program with Elementary Research-based Science) day camp held at UNH. Alicia worked side-by-side with in-service K-12 science teachers and UNH faculty to introduce students in grades 2 – 5 to engineering challenges. Alicia learned science and math education concepts that can one day be implemented in her own classroom. Martha Carlson, an Environmental Science Ph.D. candidate at UNH who graduated in December, interned with the Forest Watch program, discussed under Outcome 2.

#### ***1.4 Workforce Development -- Higher Education Support for Seminars, Conferences, Research Supplies***

*Dartmouth College Plasma Seminars.* Plasma seminars contribute to both higher education and research infrastructure by providing a regular forum for discussing ideas and inviting outside researchers to discuss ideas. With associated faculty, post-docs, students, and staff, there are about 30 scientists and engineers in the space science discipline at Dartmouth. The plasma seminar is the most important weekly event that brings together this scientific community. It plays a critical role educating students, initiating new collaborations and enhancing existing ones, and disseminating the newest knowledge in the field. Space Grant sponsored seminars this year so far included guest speakers Jerry Goldstein, Joshua Semeter, Delores Knipp, and Greg Earle.

#### ***1.5 Higher Education Faculty Curriculum Support***

*Biological Science Cross-Campus Collaboration.* Leslie Barber, Professor of Biology at Great Bay Community College, is establishing a model project for the delivery of course-sharing methodologies in order to support participation of students from system campuses in an established STEM core course, Biological Science. The goal is to enable broader student access to mathematics and science courses. Students on all CCSNH campuses will have access to seven foundational courses in biological science, each carrying an approved, major's level, and core science equivalent within USNH. Colleges may provide access to these courses either by offering them on their individual campus, or through inter-campus course sharing. This project will take up to six phases: Research and Evaluation; Equipment, Training and Experimentation; Trial Course Delivery and Corrections -- Initial course delivery experimentation will involve a small number of faculty and student volunteers; Course Equivalency Negotiations with USNH, then live course roll out followed by evaluation and strategic planning for expansion.

#### ***1.6 Higher Education Faculty Professional Development***

Space physics, remote sensing and related disciplines can be effectively combined with teaching in small college settings for general training of students and for attracting students into areas of national need. However, because these disciplines fall in between or outside of mainstream departments defined at most small colleges, scholars in these areas are often disadvantaged when applying for positions. Teaching experience can make a big difference in making these scholars attractive to small college faculties. Dartmouth College initiated the Visiting Young Scientist (VYS) program specifically to offer an opportunity for scholars within five years of Ph.D. to obtain teaching experience. As a secondary objective, the visiting scholar benefits Dartmouth faculty and students directly by collaboration in research as well as teaching.

The current VYS, Dr. Allen Pope says the following about his experience:

*“Less than two months in as a NASA VYS at Dartmouth, the Earth Sciences Department has so far welcomed me with open arms. I have contributed to the department's semester-long field program, teaching about glaciers and*



*remote sensing. With a departmental course, I have participated in retrieving sediment cores from local lakes to study past climate. I have begun to mentor a few students in the department's Remote Sensing class, helping them specifically with cryosphere-related projects. I have presented to a research group at the Thayer School of Engineering regarding methods used during my PhD, and I will be giving an "Ice & Climate" seminar as well as a departmental seminar on Remote Sensing of Ice and Snow With Landsat 8 in the coming weeks. I have gotten departmental and university-level approval for my spring term course "Polar Remote Sensing" and am moving forwards with preparing lectures and exercises for the class. All the while, I have been continuing my ongoing research projects, have maintained engagement with the both the American Geophysical Union and the Association of Polar Early Career Scientists, and have tweeted about my science @PopePolar."*

This highly successful program has resulted in at least one visiting scholar per year for seven consecutive years. Several of these scholars have gone on to become well-known in their fields; for example, Mike Wiltberger, an early visiting fellow, is now an active space physics researcher based at NCAR, and Robyn Millan, a former visiting fellow, is now assistant professor at Dartmouth and PI of a high-profile NASA balloon program.

Michael Rawlins, a relatively recent VYS, obtained an academic position at U-Mass Amherst and has been retained in a field related to NASA interests. Another recent VYS, Jeremy Ouellette, accepted a tenure track faculty position as Assistant Professor at Vermont Technical College where he is teaching and developing courses on computer security and systems analysis and computational physics, supervising sophomore-level engineering projects and advising students on career planning. His appointment as a Dartmouth VYS and the course on space systems engineering he co-developed and co-taught at Dartmouth in 2012 made him an especially attractive candidate for this new position.

### ***1.7 Research Infrastructure***

*Image Data Sets.* Landsat 5 imagery covering path 12/row 29 was acquired and processed to conform to GRANIT standards. In addition, the GRANIT archive of National Agriculture Imagery Program (NAIP) imagery was extended to incorporate new available statewide imagery data collected in 2012. Finally, additional topographic LiDAR covering areas of southern NH as well as the Isles of Shoals was added to the archive. As with all GRANIT data sets, these image products are listed on appropriate GRANIT web pages and made available to the public. The GRANIT staff developed a "time series" image service available at [http://granitweb.sr.unh.edu:6080/arcgis/rest/services/ImageServices/Landsat\\_TM\\_ETM/ImageServer](http://granitweb.sr.unh.edu:6080/arcgis/rest/services/ImageServices/Landsat_TM_ETM/ImageServer) that contains Landsat 5/7 image dates for a series of 5 time steps: 1990/1991, 1994/95, 2000, 2005, and 2008/10. At each time step, the 4 Landsat 5/7 TM scenes covering New Hampshire were mosaicked into a single, virtual image and displayed for that time step. The dataset was published as a "time aware" service so that mapping software (e.g. ArcMap) can cycle through the 5 image steps on the fly. This functionality provides an interesting look at the change in the physical landscape throughout the 20-year period – 1990-2010.

*Webinar modules.* Three webinars will be held by the end of May 2014, one in each of the months of March, April and May.

In addition to the above, progress has been made on the “What’s in a Pixel” conference initially scheduled to be delivered during the previous funding cycle. The all-day event is scheduled for April 25, 2014, at the UNH Holloway Commons Conference Center.

### ***1.8 Longitudinal Tracking***

The National Space Grant Foundation Tracking System is used to longitudinally track our NHSGC students receiving significant awards. The percentages of students who have been successfully tracked to their “next step” are: 59% for 2006; 90% for 2007; 74% for 2008; 74% for 2009 100% for 2010; 100% for 2011; 100% for 2012; N/A for 2013 (all participants still enrolled). For the 2006-2013 inclusive period, 80% have been tracked to their next step. Of these, 83% receiving significant support went on to a next step within a STEM discipline.

**Outcome 2:** *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.*

#### **Proposed and Achieved Metrics for Outcome 2 SMART Objectives**

- Supported 3 teacher workshops in STEM education (K-12), meeting the goal.
- Provided in-school and distance learning programs reaching 3500 participants, exceeding the goal of 2000 participants.
- Planning an upcoming STEM summer camp for middle school students, and provided support to a Girls Technology Day with 300 participants (goal of summer camp reaching 10 middle school students).
- Provided support for higher education students to participate in three outreach activities (goal was four activities).
- Supported Oyster River High School to participate in the FIRST Robotics competitions, meeting the goal of supporting one high school in this program.
- In the process of delivering 60 supplemental science programs in NH schools, serving an average of 35 or more students per program (goal was to serve an average of 10 or more students per program)
- Supported 5 after school/summer programs (KEEPERS, SMART, FLL, and Robotics through UNH, and LEGO Mindstorms at MSDC), engaging more than 90 school children. The goal was 15 programs reaching 200 students. The primary programs anticipated under this metric, by the Rey Center, did not occur as discussed below, but will be restarted next year.

## ***2.1 Pipeline Activities -- K-12 Teacher Development and STEM Curriculum Enhancement***

*Earth Science Workshop.* Seven STEM 6<sup>th</sup> – 12<sup>th</sup> grade teachers, plus one museum educator, learned how to incorporate carbon cycle research into the classroom at a four-day workshop held at UNH. This program was co-sponsored by Space Grant and the NASA Innovations in Climate Education project. The workshop integrated Student Climate Science NASA-based data resources and tools with a curriculum developed by GLOBE (Global Learning and Observations to Benefit the Environment).

*Middle School Educators Engineering Workshop.* Two middle school science teachers from New Hampshire attended a LEGO Engineering Institute for Educators at Tufts University in July 2013. Through hands-on, open-ended design projects the participants learned engineering concepts and associated pedagogy and educational theory. This workshop was held as a regional initiative for Space Grant, organized and hosted by the Massachusetts Space Grant Consortium.

*Forest Watch – Engaging Teachers and Students in Basic Research.* Forest Watch conducts basic and applied research on forest systems in New England, with data collected by K-12 teachers and students within the region. Research for the past 23 years has focused on the impacts of tropospheric ozone on white pines, *Pinus strobus*, a keystone species in the New England forest and a tree that grows in almost every New Hampshire schoolyard. The educational objective of Forest Watch is to build K-12 students' interest in and aptitude for science, technology, and math by engaging them in authentic science using 21st century technology. The program has regularly been evaluated by the participating K-12 teachers as well as educational consultants. Space Grant supports teacher workshops and student conferences for this program and it funds a graduate student intern who manages laboratory analysis of samples and data and outreach to teachers. During the past year, 38 in-service teachers participated in Forest Watch. Fourteen teachers attended a workshop held at the UNH campus on February 7, 2014. The teachers shared how Forest Watch is integrated into their classroom curriculum. For example: M. Handwork and S. Scarponi, teachers from Winnacunnet High School in Hampton, NH, used inquiry with their students to do research projects on light and chlorophyll in maple leaves.

*Weather Workshops for K-12 Teachers.* Middle school teachers experience the summit of Mount Washington by participating in a Winter Day Trip program. The teachers experience an in-person, in-depth look at the operations facility including the weather room and its instrumentation. The teachers meet and work with scientists and have the opportunity to talk with their students (back in the classroom) via videoconference technology. Teachers return to the classroom with first-hand knowledge and resources for lesson plans. MWO education staff follow-up with the teachers, and provide additional support for classroom content focused on STEM education.

*Rey Center STEM Curriculum Enhancement and Support.* The objective of the Rey Center's science curriculum enhancement programs is to augment and improve the life

science, Earth/space science, chemical/physical science and inquiry components in science education in New Hampshire's schools. The Rey Center is in the process of delivering approximately 60 supplemental science programs to Waterville Valley Elementary School's K-8 students between June 2013 and June 2014, equivalent to 600 contact hours with its 40 students. Additionally, the Rey Center provided two concentrated program supplements to complement the school's core curriculum. The two supplemental programs were equivalent to 60 contact hours. Rey Center science programs are developed in collaboration with teachers and meet New Hampshire Frameworks for Science Literacy Standards. Twenty-two of the supplement science programs delivered by Rey Center staff to the Waterville Valley Elementary School students were directed to grade six through eight students.

## ***2.2 Pipeline Activities -- K-12 Student Hands-on STEM Learning Activities***

*MWO On-site and Distance Learning Programs - Weather.* MWO programs, both in-person and via videoconference, support STEM education and provide additional classroom resources. The use, design, and maintenance of technology utilized by meteorologists to measure and record weather conditions atop Mount Washington are presented. Teachers are encouraged to work with their students to create their own weather station and maintain daily weather records at their school's location.

*White Mountains Community College STEM Summer Camp.* The White Mountain Community College's STEM camp is an outreach program supported by the North Country Health Consortium, the New Hampshire Experimental Program to Stimulate Competitive Research (NH EPSCoR), the New Hampshire Space Grant Consortium, and the Northern New Hampshire Area Health Education Center. Planning and organizing is currently underway for this year's five-day Science, Technology, Engineering, and Mathematics camp to be held in June, designed for students entering grades 6 through 8. The camp provides hands-on, fun-filled activities that are meant to be introductory, interactive, and project-based in the areas of science, technology, engineering, and mathematics. Students who attend share a desire to engage in scientific inquiry and are interested in science, technology, engineering, mathematics, and health careers. STEM Camp Activities include LEGO Robotics, Discovering Computer Hardware, Global Positioning Systems, Forensic Science, Veterinary Medicine, First Aid and Wilderness Medicine, and Aerospace Rocketry. The NH Space Grant Consortium is a prime sponsor.

*KEEPERS (Kids Eager for Engineering Program with Elementary Research-based Science).* UNH hosted 3 one-week sessions of engineering day camp in Summer 2013 aimed at children in grades 2 – 5. Sixty students were engaged in hand-on activities that developed inquiry and design skills through engineering challenges. (This program was supported by Space Grant through the internship of Alicia Reynolds, discussed under Outcome 1.)

*Project SMART. (Science and Mathematics Achievement through Research Training).* Eight high school students spent four weeks on the UNH campus during Summer 2013,

working together with faculty mentors and in-service high school teachers to design, fabricate, test, and launch experiments aboard high-altitude balloons. The purpose of the payloads was to measure cosmic rays and environmental parameters at the edge of space. Students get hands-on experience building electric components (such as microcontrollers) and re-entry vehicles. After flight, the students analyze the data that was stored onboard.

*First Robotics.* Space Grant supported the Oyster River High School's FIRST Robotics Team, *The River's Edge* (#3499). The 23 high school students worked with mentors from technical professions (including a staff scientist from UNH) to build a robot and compete in this year's engineering and design challenge. The team placed 9<sup>th</sup> in a regional competition held at the campus of lead affiliate UNH. They also took part in a second regional competition held at Northeastern University.

*FIRST LEGO League.* In addition, Space Grant provided earlier years' robotic kits to support the following FIRST LEGO League activities: two kits went to the ORHS team (#3499) for use in their outreach programs and mentoring of FLL teams; one went to a teacher in Barrington, NH, who is interested in starting an FLL team; two went to two new FLL teams in need – one in Ossipee, NH, and a Girl Scout team in Rochester, NH.

*Rey Center After School Programs.* Unfortunately, the co-funding for this program did not materialize this past year, but new funding has been found for next year.

*LEGO Mindstorms.* This weeklong middle school program was supported at MSDC under the Space Grant internship (discussed in Outcome 1).

*e-Start.* Since 2008, the Community College System of New Hampshire has partnered with the Virtual Learning Academy Charter School (VLACS) to offer "e-Start" courses in which students earn dual high school and college credits for on-line courses. VLACS is New Hampshire's first statewide, on-line high school. e-Start courses are taught by certified instructors. The goal is to use the latest internet technologies to provide students with anytime, anywhere access to a rigorous, personalized education. On-line learning is one of the fastest growing segments of the Community College curriculum. e-Start courses are geared toward engaging high school learners through a discounted rate, transferrable credits, and flexibility.

The NASA Space Grant supports a STEM e-Start course, Biology 1, by funding tuition for students who take the course. The course provides an introduction to the basic principles of biology, including the structure of cells, cellular respiration and biochemistry, physiological processes, genetics, and heredity. This is a fast paced course and in which students are expected to spend a minimum of 10 hours a week on reading and on course assignments. This year Space Grant funding has been provided for 18 high school students who have taken the course. Next year ten more students will be funded.

### ***2.3 Pipeline Activities - STEM Recruitment in Middle and High School***

*WIST Forum.* White Mountains Community College held their 4th annual WIST (Women in Science and Technology) Forum April 4, 2014, at the College in Berlin, NH. The WIST Forum provides middle and high school women with a unique opportunity to meet, listen to, and talk with professional women who have successful careers in STEM. The event features keynote addresses and panel discussions designed to inspire and motivate the pre-college students who might be considering pursuing higher education in STEM. This year's forum included more panelists with broader diversity of professions. Panelists included specialists in Chemistry, Earth and Climate science, Mathematics and Atmospheric Science, Geology, Forestry, Environmental Science, Wildlife Biology, and Bio-engineering. The panelists speak about their learning and career paths. Panelists are from Dartmouth College, NH Fish and Game, White Mountain National Forest, IBM – to name a few. Through the NASA Space Grant, the Community Colleges of New Hampshire Foundation provides support to this successful forum. This forum also provides a venue for dissemination of materials to “get the word out” that there are NASA scholarship opportunities for women who decide to attend the community college system.

NHTI's WIST day is supported by New Hampshire Experimental Program to Stimulate Competitive Research (NH EPSCoR), PSNH, Red River, People's United Bank, Freudenberg NOK, Liberty Mutual Insurance, the New Hampshire Space Grant Consortium, Alexander Technology Group, IOL UNH, Dyn, ITM Partnership, and the NH Department of Education.

Space Grant funding is being used for the planning of next year's Women in Science and Technology Forum to be hosted by FIRST in Manchester, NH. This WIST is a one-day conference, which will be held with a tentative date of November 7, 2014. This highly popular forum began in 2000 as a way to introduce high school girls and their teachers to the career options available in science, technology, engineering and math. This unique event provides 250 young women and men with an opportunity to meet new contacts and build networking relationships that continue beyond the Forum. Past Forums have been filled to capacity and have routinely received high evaluations from presenters and participants both for content and execution.

*Girls Technology Day.* NHTI, Concord's Community College, held a Girls Technology Day on March 19, 2014. This event was launched in 2013 to promote STEM careers in NH to girls in grades 8, 9, and 10. Last year, this event had 150 young women attending. This year 300 attendees registered, and there were over a hundred more on a wait list. Some examples of the sessions for Girls Technology Day featured breakout panels in: 3D modeling, VEX robotics, Reverse Engineering, Industrial Robotics, and Making Ethernet Cables. There were exhibitors from BAE, the McAuliffe Shepherd Discovery Center, IEEE, Tech Ed Concepts, UNH Manchester, UNH Engineering, Lunar Cats, the Society of Manufacturing Engineers, Portsmouth Naval Shipyard, Manchester Community College, NHTI. Through Space Grant funds the NH Space Grant Consortium was recognized as a Gold Star Sponsor.

*Dartmouth Student Outreach.* Dartmouth graduate students take part in outreach events to benefit the broader community, while instilling in themselves the value of communicating space science with the public. An example of this year's activities included participation in Earth and Space Day at the Montshire Science Museum. Graduate students from Dartmouth's Astronomy program led activities such as creating a scale-model of the Solar System that fits in a pocket, and building a representation of a comet from water, dirt, ammonia, organic material, and dry ice. They also conducted demonstrations of how astronomers use light and spectra to learn about the universe. School-age children (Outcome 2) and other members of the public (Outcome 3) were able to learn what it is like to be an astronomer with an Ask-an-Astronomer discussion. In addition, Dartmouth graduate students participated as panelists in the WIST Forum, discussed earlier (Outcome 2) and in hosting the Women in Academia Panel held at Dartmouth in January. This panel included four female faculty members (engineering, Earth science, EEB, and Physics and Astronomy) sharing their experiences in becoming faculty members.

**Outcome 3:** *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.*

#### **Proposed and Achieved Metrics for Outcome 3 SMART Objectives**

- Supported a 1-day aerospace festival reaching 408 members of the general public and a 2-day astronomy festival reaching more than 1000 members of the general public, exceeding the metric goal of a two day festival reaching 500 members of the general public.
- Supported 2 informal educators in attending professional development conferences/workshops, meeting the metric goal.
- Provided hands-on citizen science programs in rural New Hampshire to 649 participants, exceeding the metric goal of 300 participants.

#### **3.1 Priming the Pump -- Engaging the General Public**

*Aerospace Festival MSDC.* Aerospacefest was held at MSDC on June 8, 2013. 408 people (primarily families with children in Pre-K, elementary, and middle school) participated in a wide variety of STEM activities. Participating partners in Aerospacefest included NHSGC lead institution UNH, and affiliates Plymouth State University (weather balloon launches and tracking), the Community College System of NH (use of NHTI quad for activities and NHTI parking lots for remote-controlled airplanes and helicopters), and FIRST (Team 4-1-1 FIRST Lego League, demos and activities for participants). Other participating groups/high-tech companies/institutions included Raytheon, iGlobe (interactive globe - weather), Squam Lakes Science Center, NH Civil Air Patrol, NH Flying Misfits (remote-controlled airplanes and helicopters) NH Department of Transportation Bureau of Aviation (aviation art contest and activities), Aviation and Space Education Council, Fliskits Model Rockets (model rocket construction and launching), Mad Science (interactive science demos), NH Astronomical

Society (telescope viewing), and ReVision Energy (alternative energy activities). Scholarship awards were presented to the winners of the statewide Astronomy Bowl (three college scholarships funded by corporate sponsors) and the Alex Higgins Space Camp Scholarship (sending three children to U.S. Space & Rocketry Camp in Huntsville AL, funded by NH Charitable Foundation and the Higgins family).

*Astronomy Festival UNH.* In collaboration with the UNH Department of Physics and the New Hampshire Astronomical Society, NHSGC supported the third annual New England Fall Astronomy Festival (NEFAF), a two-day event held at the University of New Hampshire Observatory September 13 – 14, 2013. Participants included Space Grant affiliates UNH, the Rey Center, MSDC, and PSU. UNH and affiliate BAE Systems of North America were also sponsors of the event. The keynote speaker was author and playwright Dava Sobel, whose works include *Galileo's Daughter* and *A More Perfect Heaven: How Copernicus Revolutionized the Cosmos*. In addition to speakers there were hands-on activities for all ages, model rocket launches, and opportunities to observe with telescopes both daytime (solar) and nighttime.

*Rey Center Citizen Science.* The Rey Center's citizen science programs are hands-on participatory programming that create meaningful learning experiences, improving participants' science literacy, and developing knowledge and motivation that enables citizens to actively engage in making informed decisions about the natural environment. The Rey Center delivered an array of citizen science and science outreach programs in 2013-14. Through the Welch Ledges Stewardship and Citizen Science Program, over 300 contacts were made with hikers by Welch Ledge Stewards; stewards educate recreationists on the unique alpine-like communities on Welch Mountain in Thornton, NH. Ninety-one fifth grade students, 15 public participants, and 40 undergraduate students (from affiliate PSU) partook in a Welch Ledge Stewardship Hike and were introduced to the ecology of the northeastern forest along an elevation transect, the fragility of alpine mountain environments, and individual responsibility for stewardship. The Rey Center also continued its Water Watchers program. Water Watchers creates a rich citizen science opportunity for the public to monitor the overall health of important local water sources. Staff and volunteers conducted 12 water-quality monitoring sessions. The Dark Sky Nights program engaged 199 participants in observations of the night sky in Waterville Valley, NH.

*MWO Open House Expo.* A week-long series of programs were held the week of February 17, 2014 at the MWO's Weather Discovery Center. Topics included: Fundamentals of the Earth's Climate, Ecology of the White Mountains, and Global Weather Events of 2013. Affiliate PSU participated in the Open House, bringing a "Doppler on Wheels" and providing visitors with the opportunity to learn about how it operates.

*MWO Public Education Programs.* One- and two-day educational programs are offered to the public (ages 16 and up) at the summit of Mount Washington. Participants are immersed in a variety of science topics, including the weather on Mount Washington. In



the one-day program, 118 members of the public participated, and there were 77 participants in the two-day program.

*MSDC Exhibit Evaluation.* Education consultants from Executive Service Corps evaluated the ability of MSDC's electromagnetic spectrum (EMS) exhibits and associated program "Stellar Forensics" to convey content information, improve students' comprehension of the EMS, and increase students' enthusiasm for STEM. The EMS evaluation, completed by ESC in June 2013, found that on average, the 277 students tested demonstrated a 13% improvement in content knowledge and comprehension, and an overall positive improvement in enjoyment of STEM, including 33% of the students desiring to pursue careers in STEM fields. MSDC has begun an upgrade to its website, in order to have the capacity to include an EMS interactive (and other interactive activities) on its website. Evaluation of MSDC's homeschool, toddler and educator workshops is currently underway, as well as the effectiveness of docent interactions with the general public in improving visitor STEM content knowledge.

### ***3.2 Priming the Pump -- Informal Educator Development***

*Informal Educator Conferences.* Two MSCD staff attended professional development workshops this year. Education Coordinator (Exhibits) Timothy Taber attended the Annual Meeting and Conference of the Association of Science and Technology Centers in Albuquerque, NM. He attended workshops on astronomy, space science, math, engineering and electronics, and exhibit safety and sustainability. Education Coordinator (Programs) Tiffany Nardino traveled to the New England Museum Association's annual conference in Newport, RI. She attended workshops and networked with museum professionals to increase her knowledge regarding educational programs for a wide variety of ages and abilities, plus engaging volunteers in educational offerings.

## **PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES**

- **Student Data and Longitudinal Tracking:** Total significant awards = 48; Fellowship/Scholarship = 41, Higher Education/Research Infrastructure = 7; 4 of the total awards represent underrepresented minority funding. During the FY13 program year 10 students are pursuing advanced degrees in STEM disciplines, 1 accepted a STEM position at a NASA contractor, 18 accepted STEM positions in industry, 2 accepted STEM positions in K-12 academia, 7 accepted STEM positions in academia, and 12 went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.
- **Minority-Serving Institution Collaborations:**  
This past year, NHSGC began a new initiative with its longstanding collaboration with Elizabeth City State University (a minority serving institution in North Carolina). In addition to the academic year student support and mentorship, two full

summer internships were provided onsite at the UNH campus to ECSU undergraduates (discussed under Outcome 1).

- **NASA Education Priorities:**

- Authentic, hands-on student experiences in science and engineering disciplines.

All awarded internships provide hands-on experience.

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

The mission of the Women in Science Project (WISP) at Dartmouth College is to collaborate in creating a learning environment where women can thrive in science, engineering, and mathematics. Space Grant provided funding support to 14 WISP interns this past year, including one at JPL.

Within the consortium, the Director and Assistant Director, as well as the Affiliate Directors at Dartmouth, the Rey Center, MSDC, the Community College System, FIRST, and the Cooperative Extension are female.

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise.

The MWO Winter Day Trip is focused on middle school teachers. They work side-by-side with scientists in the weather room atop Mount Washington, and return to their classrooms with new resources for lesson plans. The Middle School Educators Engineering workshop (held at Tufts University) and the Earth Science Workshop (held at affiliate UNH) were aimed at in-service middle and high school science teachers. Forest Watch participants include in-service middle school teachers.

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

Summer activities on college campuses supported by Space Grant include the White Mountains Community College STEM Summer Camp; Project SMART at UNH and KEEPERS at UNH.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

The Community Colleges of New Hampshire Foundation is a fully engaged affiliate of the NHSGC. As described under Outcome 1 and under Improvements, one of the initiatives this year is the development of the new Biological Science Cross-Campus Collaboration, which will include Course Equivalency Negotiations with USNH. The community college also provides, with Space Grant support, activities to engage and inspire K-12 students into STEM areas. These events, such as the WIST Forum, include participation by students and/or faculty from Dartmouth College, Lyndon State College, and UNH.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

Citizen Science programs offered by the Rey Center improve science literacy on topics related to Environmental Science such ecology, water quality, and the fragility of alpine mountain environments. MWO provided a one-week series of programs at their Weather Discovery Center on topics such as Earth's climate, ecology of the White Mountains, and Global Weather Events of 2013.

This year's Dartmouth Visiting Young Scientist is engaged in climate change educational and research activities discussed under Outcome 1. Graduate student fellowships are funding research on the understanding of how large ice sheets impact sea level (UNH); climate change history in Peru (Dartmouth); the Greenland ice sheet (Dartmouth, UNH); and Holocene climate change (Dartmouth).

The Earth Science Workshop held at UNH was focused on the Carbon Cycle, and included curriculum materials developed by GLOBE (Global Learning and Observations to Benefit the Environment).

- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

The Dartmouth College Visiting Young Scientist program specifically offers an opportunity for scholars within five years of PhD to obtain teaching and research experience. This year's VYS is engaged in polar ice and climate activities.

## **IMPROVEMENTS MADE IN THE PAST YEAR**

The University System of New Hampshire (USNH) and the Community College System of NH (CCSNH) is committed to increasing the number of graduates in STEM fields. It

is anticipated that by 2020, 14% of job openings in NH will be in STEM fields. The Chancellors and Presidents of both USNH and CCSNH systems met in January 2014 to discuss strategic collaborations, including STEM Program Advancement.

Part of this collaborative effort is getting the word out. Space Grant funded external promotion activities by the community college system in order to build strategic partnerships and linkages between the community colleges and STEM formal and informal education providers. Dissemination efforts also promoted STEM post-secondary education and initiatives at the Community Colleges. With this portion of the NASA Space Grant, the goal was to raise awareness within the state of how the Community Colleges can serve as a pathway to NASA opportunities. Increased visibility of the Community College's NASA Space Grant opportunities is obtained through the website and in print media, such as pamphlets, posters, and press releases distributed to newspapers state-wide. The application process was streamlined, and an improved STEM presence was established on the CCSNH website (<http://www.ccsnh.edu/academics/stem-studies-science-technology-engineering-math>). As a result of these efforts, in award year 4, (2013-2014) the Space Grant program received 42 applications, up from 33 in award year 3. This increase was in part due to the increased marketing effort. Another part of this new community college and university collaboration involves generation of courses that can be taken at the community college level, and later transferred to the university level. One such endeavor is the new Biological Science Cross-Campus Collaboration discussed under outcome 1.

In terms of improving evaluation systems, MSDC underwent the first (of several) planned program and exhibit evaluations, and is currently in the process of completing additional evaluations. In its strategic plan for years 2014-2016, MSDC included as a goal, "developing a culture of evaluation." This will be accomplished through on-site evaluations as well as professional development for staff in the methodology and purposes of evaluation. This was quantitatively discussed under Outcome 3.

## **PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION**

The NHSGC has nine members. The lead institution is the University of New Hampshire, including UNH Cooperative Extension, with associate Dartmouth College, and affiliates FIRST Place, the Community College System of New Hampshire, the McAuliffe-Shepard Discovery Center, Plymouth State University, the Mount Washington Observatory, the Margret and H.A. Rey Center, and BAE Systems of North America.

The University of New Hampshire (UNH), located in Durham, NH, is the state's flagship research university, enrolling 12,565 undergraduates (54% female) and 2,196 graduate students. Research and PhD programs relevant to aerospace are offered in physics, engineering, math, computer science, and a cross-college program in natural resources and Earth system science.

A part of UNH is Cooperative Extension that provides NH citizens with research-based

education and information, enhancing their ability to make informed decisions that strengthen communities, sustains natural resources, and improves the economy. Space Grant collaborations are in the areas of geospatial technology and applications, resource management, and workforce development.

Dartmouth College, located in Hanover, NH, is a private liberal arts college (ninth oldest in the nation) and a member of the Ivy League. The college has 4,200 undergraduate students and 2,100 graduate students. Aerospace-related undergraduate and doctoral degree programs are offered in physics and astronomy, engineering, computer science, and Earth science. Extensive research is conducted in solar-terrestrial physics, astronomy, satellite remote sensing, robotics, and computer science applications.

The Community College System of New Hampshire (CCSNH, formerly the New Hampshire Community Technical College System) is New Hampshire's statewide system of two-year colleges, offering associate degrees, professional training, and transfer pathways to four-year degrees. CCSNH is comprised of seven colleges within the state: Great Bay Community College in Portsmouth; Lakes Region Community College in Laconia; Manchester Community College in Manchester; NHTI-Concord's Community College in Concord; Nashua Community College in Nashua; River Valley Community College in Claremont and Keene; White Mountains Community College with locations in Berlin, Conway, and Littleton. CCSNH is the primary provider of skilled workers and technicians in the State. Space Grant supports a NASA scholarship program for STEM students, linked to the private sector and also supports STEM curriculum development within the college system.

Plymouth State University (PSU), located in Plymouth, NH, is part of the University System of New Hampshire and has a current student enrollment of 4,065 undergraduates and 2,443 graduate students. Space Grant funding provides research-oriented scholarships and fellowships in the meteorology program, with an emphasis on providing support to women undergraduate students.

FIRST Place is an innovative R&D facility in Manchester, NH, linked to Dean Kamen's nationwide FIRST robotics programs. It provides students, teachers, and the general public an encouraging environment for exploring concepts of science and technology. FIRST Place collaborates with UNH in curriculum development for pre-college science teachers. UNH and BAE Systems provide mentors and support for NH school teams involved in FIRST competitions.

The Mount Washington Observatory (MWO), in the White Mountains of NH, is a non-profit organization providing environmental observation and education while supporting scientific research. Current research projects address summit weather and climate, regional air quality, and global tropospheric chemistry. MWO, UNH, and PSU work together on many Space Grant activities, including internship and research projects.

The mission of the McAuliffe-Shepard Discovery Center (MSDC), located in Concord, NH, is *to educate, incite, and entertain learners of all ages in the sciences and*

*humanities by actively engaging them in the exploration of astronomy, aviation, and Earth and space science.* As many as 50,000 school children and other visitors explore the Center annually, and another 10,000 are reached through offsite outreach programs, such as the portable planetarium. The Center is NASA's Educator Resource Center for NH. Space Grant supports internships, the development of planetarium shows and exhibits, teacher workshops, and space science fairs, often in collaboration with other NHSGC affiliates.

The Margret and H.A. Rey Center, in the Waterville Valley, honors the legacy of Margret and Hans Rey, authors of Curious George books and *The Stars, a New Way to See Them*, among other works. The Rey Center provides initiatives in environmental stewardship and informal educational programs in the astronomy and local ecological systems. NHSGC resources are used by the Rey Center to initiate several citizen science community outreach programs and cooperative research initiatives. Among these are the Tecumseh Overnights Program, Tecumseh Vegetation Phenology Research Transect, the Lorenz Weather Station, and the Water Watchers water quality-monitoring program.

BAE Systems of North America is part of an international company that develops and supports advanced defense and aerospace systems, and is headquartered in Nashua, NH. BAE Systems supports and mentors teams for FIRST Robotics, FIRST Tech Challenges, and FIRST Lego League.

**The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**